WaterSMART ACF Focus Area—Water Use

- Working group: John Clarke (GaWSC), John Jones (ER Geo Sci Ctr), Trey Grubbs (FlWSC), Nancy Barber (GaWSC)
- Goals:
  - Improve understanding of current withdrawals and return flows in the ACF basin.
  - Provide data for calibration of GW and SW models.
- Build on existing programs:
  - USGS 5-year water use report (in cooperation with State agencies),
  - A cooperative study in Georgia to quantify irrigation withdrawal using metered data,
  - Research investigations using crop, climatic, and remote sensing data to estimate agricultural withdrawal.

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Water Use—Major Tasks

- Compile Water Withdrawal and Return Flow Data for selected years during 1999-2011
  - Non-Irrigation Withdrawals
  - Irrigation Withdrawals
  - Determine return flows (discharges)
- Estimate net use
- Compile Water Use Projections

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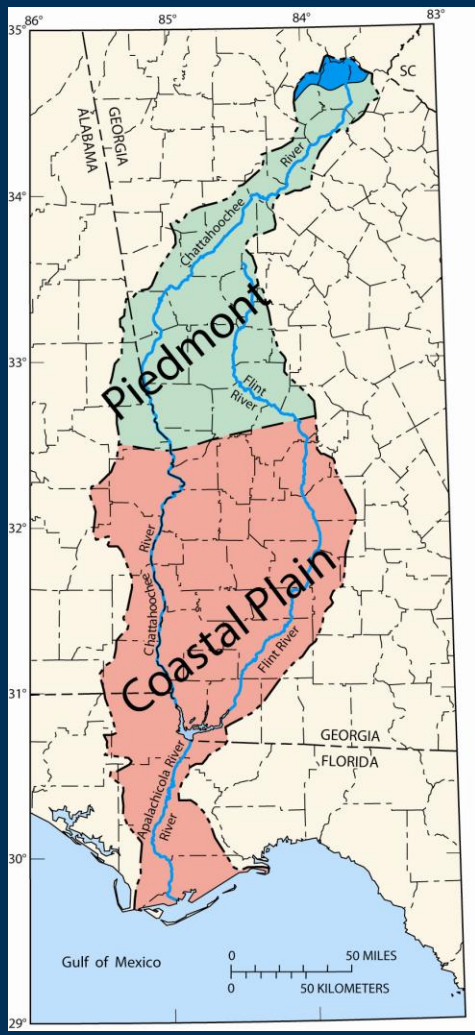
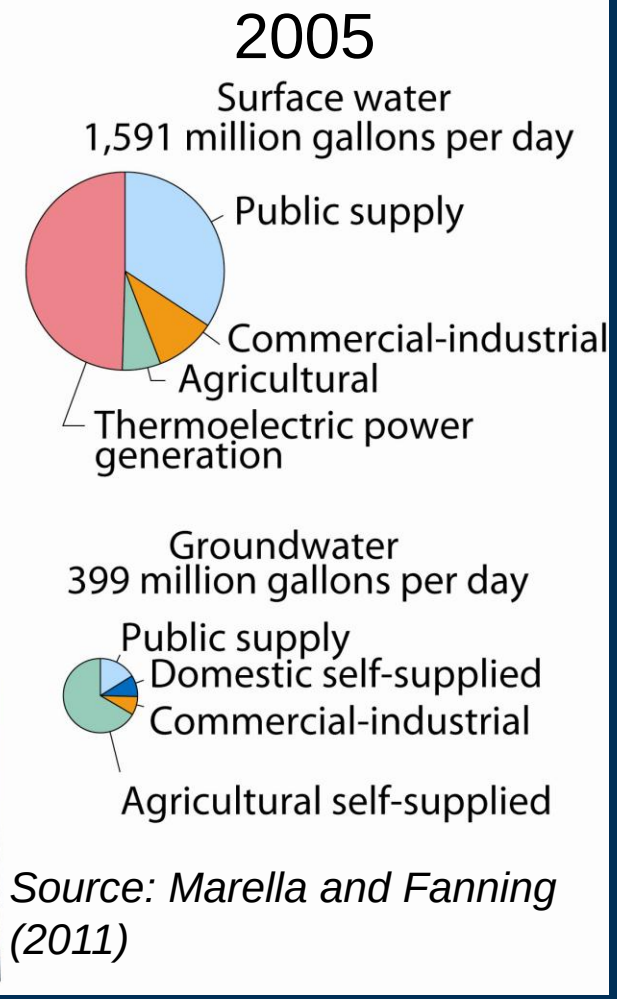
Water Use in The ACF Basin

- Northern area: Mostly surface water
  - Major water users: City of Atlanta, as well as Gwinnett, DeKalb, Fulton, and Cobb Counties in Georgia
- Southern area: Mostly groundwater
  - Major water use is irrigation
  - Karst setting
- Thermoelectric plants in both areas





Source: Marella and Fanning (2011)

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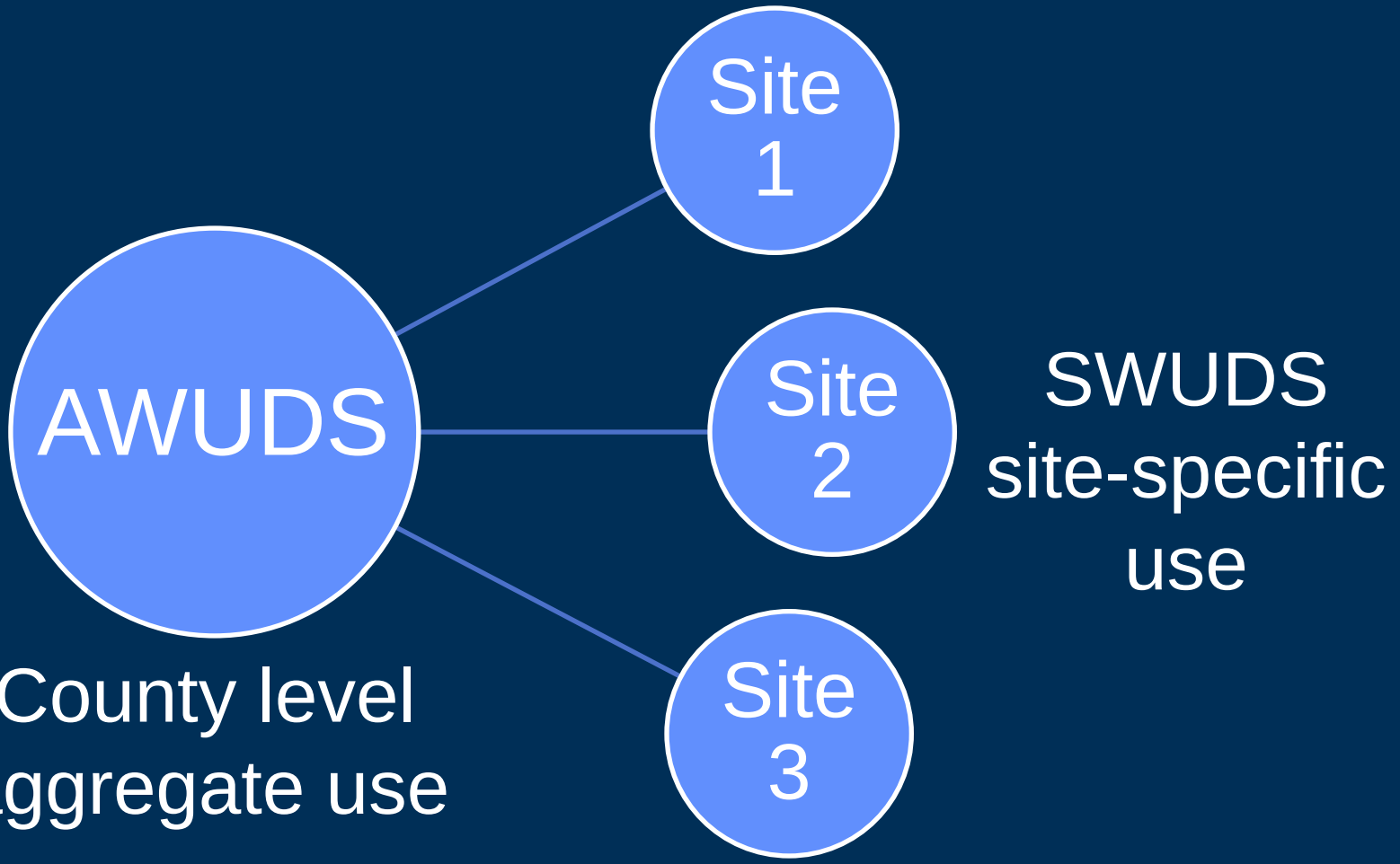
Compile Water Withdrawal Data for 1999-2011

- Develop aggregate database for 2010 (county level) as part of 5-year report
- Create SWUDS databases in each State (Site Specific Water Use Data System)
  - Part of USGS National Water Information System
  - SWUDS provides site specific breakdown on fate of water from withdrawal point to discharge point

USGS

SWUDS enables division of aggregate use into site-specific use



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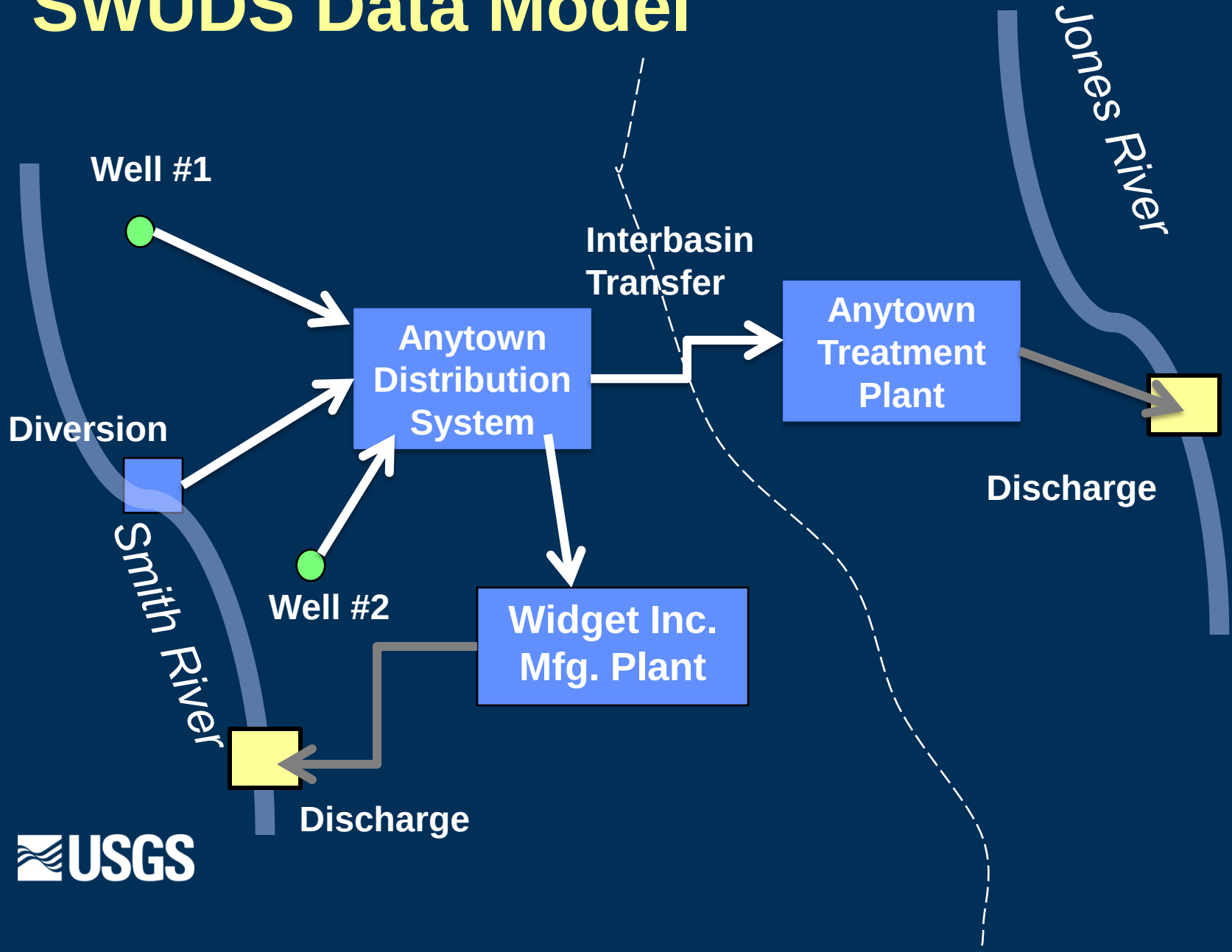
SWUDS Data Model



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Compile Water Withdrawal Data for 1999-2011—Non Irrigation

- Compile data from available sources in each state—permit databases
- Estimate data where needed
- Input data for periods of model calibration during 1999-2011 (includes monthly)

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Compile Water Withdrawal Data for 1999-2011—Irrigation

- Available metering data in Georgia and reported data in Florida will be compiled
- Develop new methods to estimate agricultural withdrawals during time periods and in areas not covered by metering program
- Compare new estimates to GaMP data

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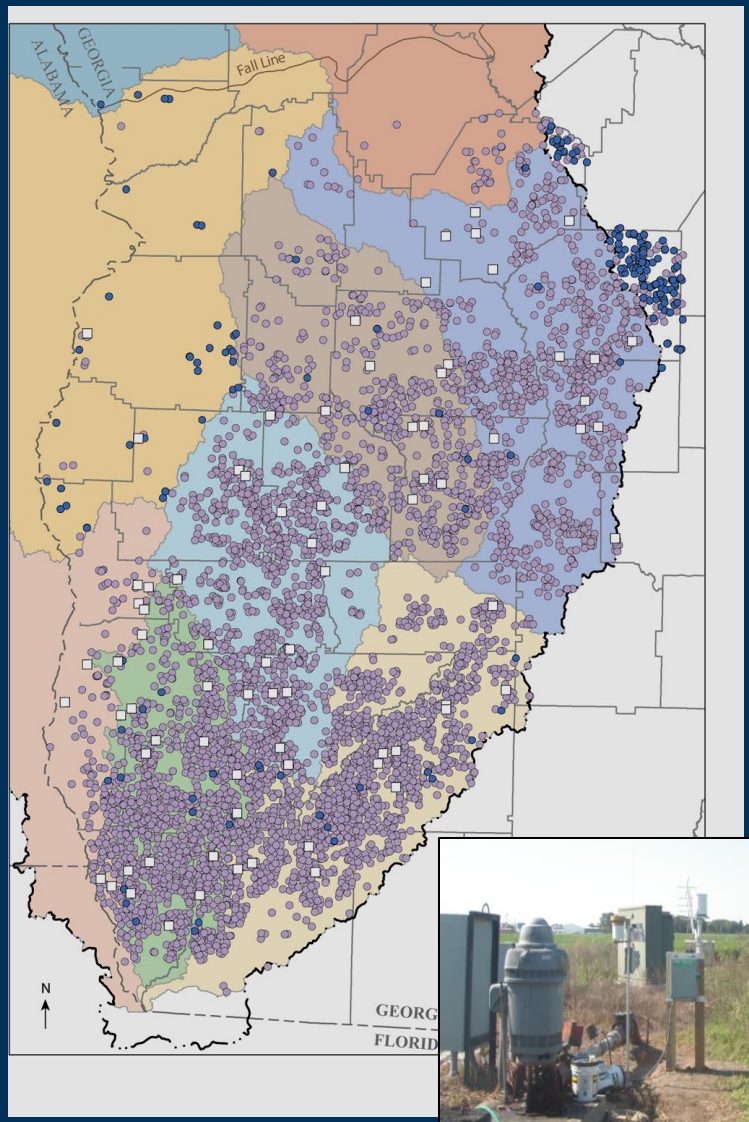
Georgia Agricultural Water Conservation and Metering Program

Program run by Georgia Soil and Water Conservation Commission

ACF Basin (2007-present)

- 81 Telemetry sites
  - 46 GW
  - 35 SW
- 4,357 Annually reported sites
  - 3,609 GW
  - 748 SW
- Geospatial analysis provides annual and monthly estimates of withdrawals (Coop program with USGS)



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Estimation of Irrigation Use

- Crop type, weather, and irrigation demand
- Remote sensing

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Estimation Based on Crop type, Weather, and Irrigation Demand

(Trey Grubbs, FlWSC)

- Approach: ***Estimate monthly gw withdrawals for irrigation at permitted well locations by assuming irrigation withdrawals are approximately equal to irrigation demands***

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Estimating Crop Irrigation Demand

Data Needs:

- **Data on types and areas of irrigated crops grown in individual counties**
- **Weather data (P, T_{max}, T_{min}, T_{dew}) from PRISM Climate Group, http://www.prism.oregonstate.edu/)**
- **Crop characteristics: ET coefficients, rooting depths, planting seasons, maturation, and allowable water depletion data**
- **Soils data (available water storage): NRCS Soils GIS data**
- **Irrigation efficiency, ratio of irrigation from gw & sw**
- **Locations of irrigated areas and/or active irrigation wells**

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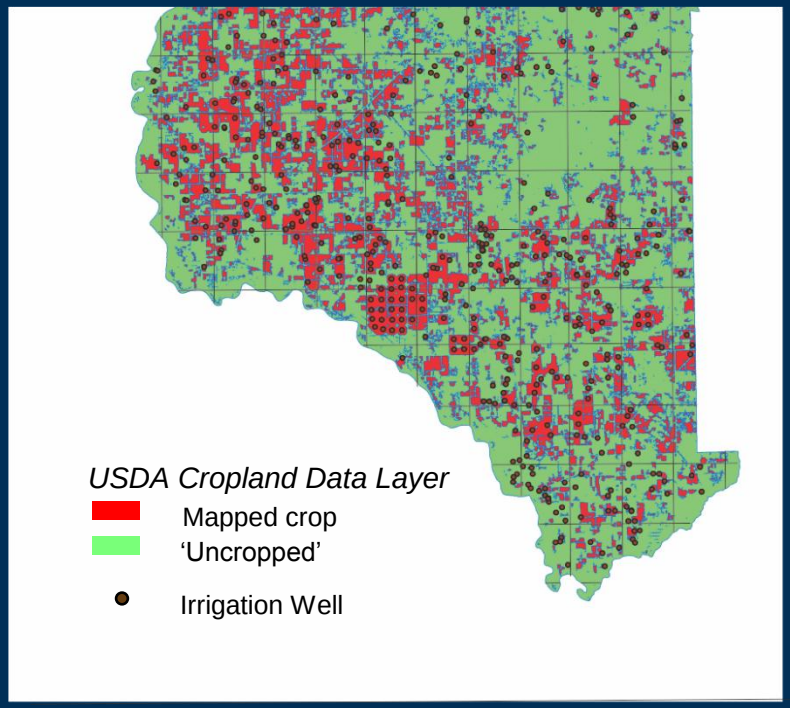
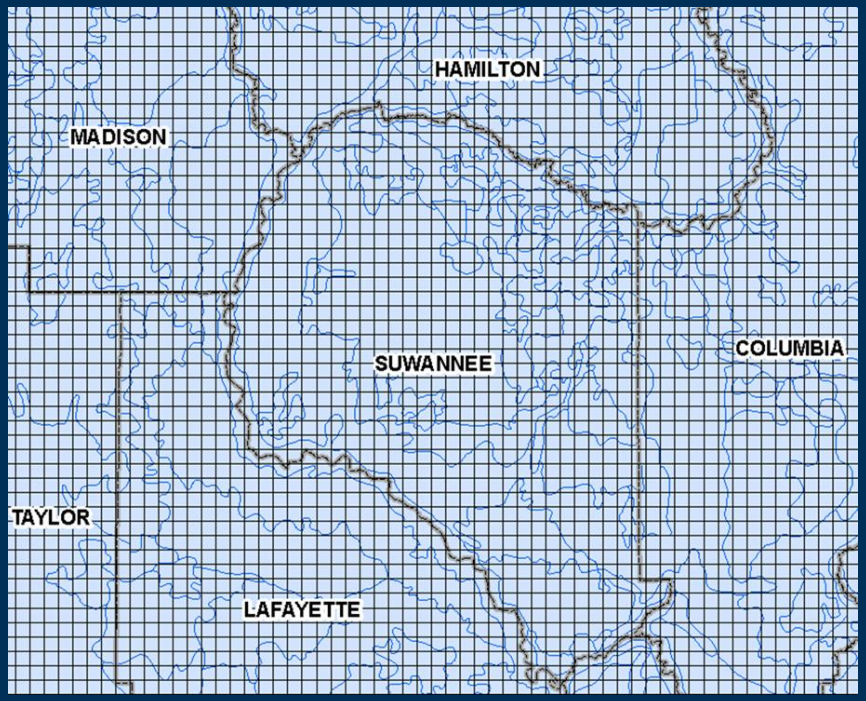
Mapping Irrigation Demand

Subdivide study area based on unique combinations of county, planting zone, soil, PRISM weather grid cell boundaries, and areas of active irrigation



Irrigated areas



GIS Intersection of PRISM Grid, NRCS Soils

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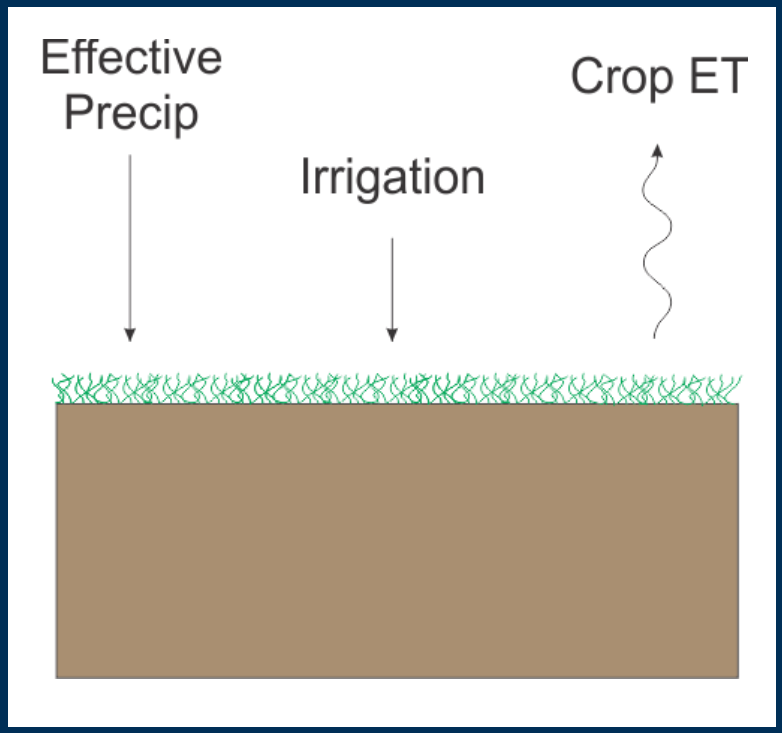
Estimate Irrigation Demand in each 'Irrigation Polygon'

1. Estimate crop ET
2. Estimate effective precipitation
3. Compute difference between crop ET and effective precipitation



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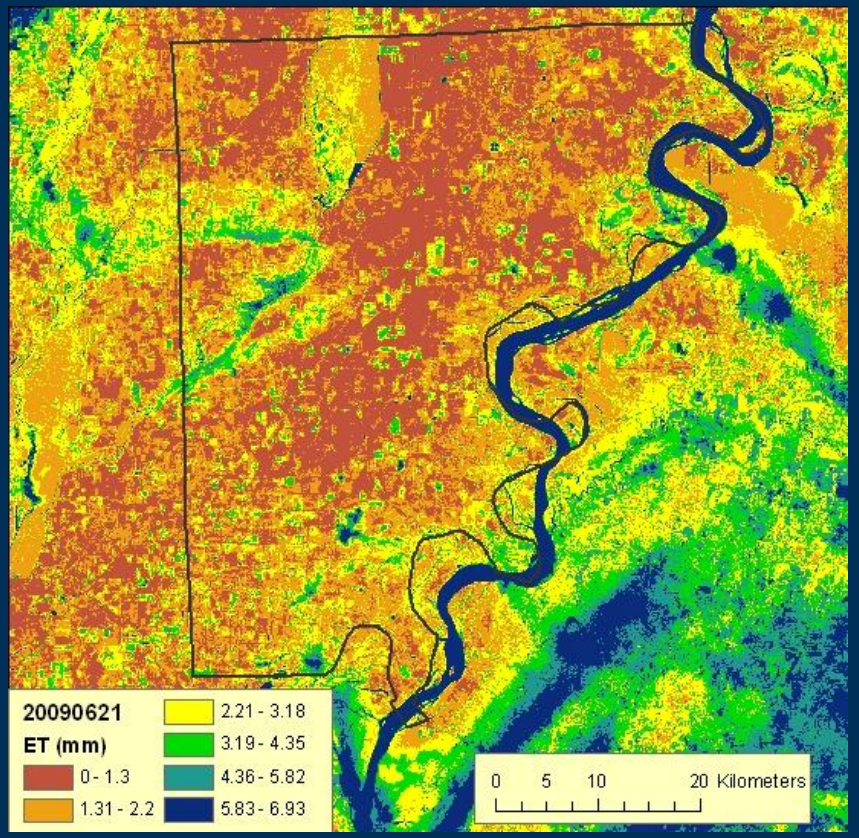
Estimation Based on Remote Sensing
(John Jones, ER Geo Sci Ctr)

- Based on prototype work in the Yazoo River Delta region of Arkansas and Mississippi
- Approach
  - Use satellite imagery to develop maps:
    - Irrigated lands
    - Evaporation
  - Develop statistical relations to determine amount of water applied to crops (agricultural withdrawal)



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Net Water Use

- The difference between water withdrawn and returned to a basin in a given timeframe, and is thus the net effect of all withdrawals and return flows (Fanning, 2007). Includes:
  - Consumptive use: water which is evaporated, transpired, incorporated into a product or a crop, consumed by humans or livestock, or otherwise removed from the immediate water environment,
  - Interbasin transfers,
  - Groundwater discharged from supply systems to streams (i.e. withdrawn from a well and discharged into a stream),
  - Septic-system usage

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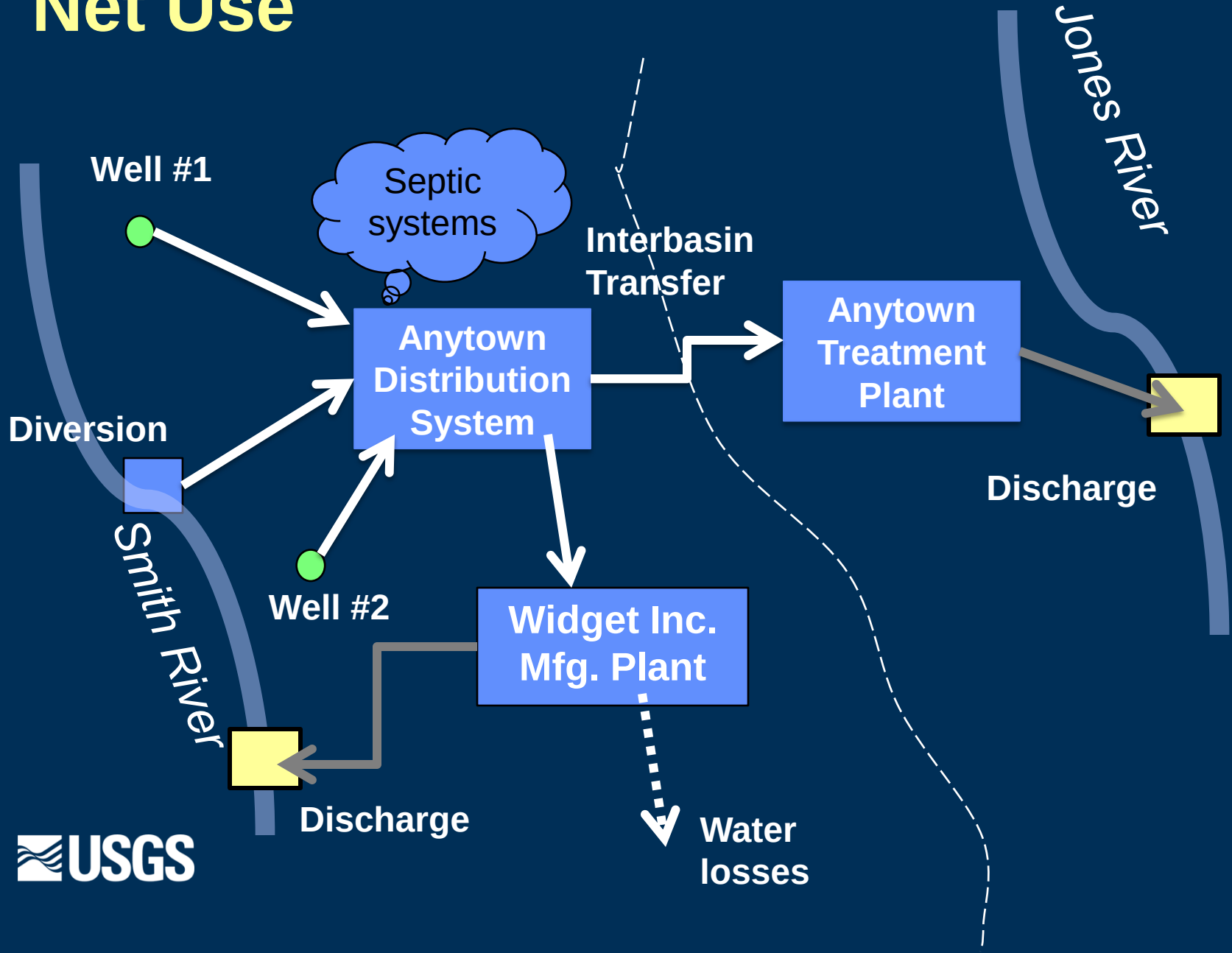
Net Use


Well #1
Septic systems
Interbasin Transfer
Jones River
Anytown Distribution System
Anytown Treatment Plant
Diversion
Discharge
Smith River
Well #2
Widget Inc. Mfg. Plant
Discharge
Water losses
USGS

Net use varies from the North to South parts of the ACF basin

- **Northern area:**
  - surface water is primary source
  - largest loss of water is from public-supply systems, with substantial interbasin transfers.
- **Southern area:**
  - groundwater is primary source
  - largest loss of water is from irrigation
- Net use typically is highest during droughts and summer months when streamflow is low (Landers and Painter, 2007).

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Return Flows

- Establish discharge sites in SWUDS database
- Quantify discharge
  - Permit data (NPDES permits)—varies by State
    - NPDES data typically are stored in a variety of file locations with different reporting requirements, with no centralized database for dissemination and analysis
  - Thermoelectric consumptive use being estimated as part of WaterSMART study (National scope)

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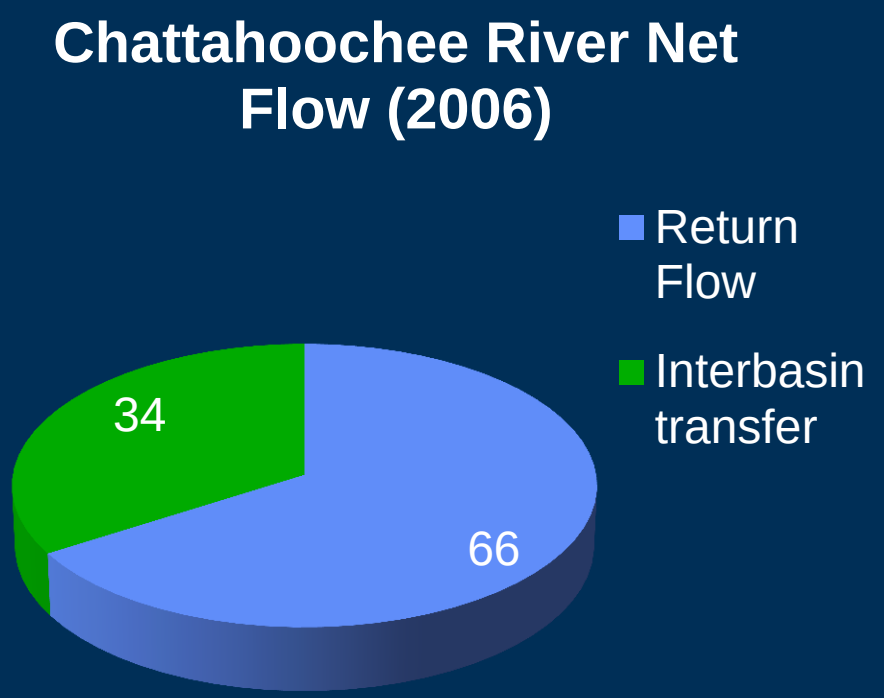
Interbasin Transfers

- Mostly a factor in the northern part of basin
- Have existed since the early 1900s, with most resulting from public supply use in the metropolitan Atlanta region (Draper, 2005).
- The river basins in metropolitan Atlanta are long and narrow, and many public-supply systems extend over more than one basin.



Source: Metro North Georgia Water Planning District, Water Supply and Water Conservation Management Plan, 2009

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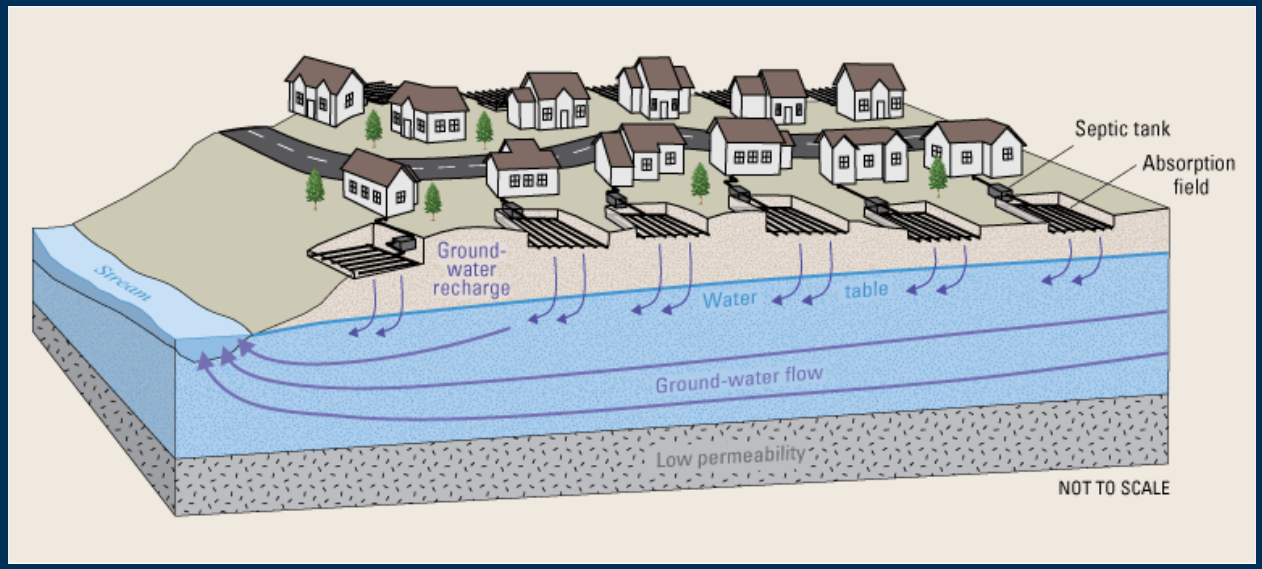
Septic Systems



- Septic systems in metropolitan Atlanta previously assumed to be fully consumptive;
- Studies by Landers and Ankcorn (2008) indicate groundwater contribution to streamflow was 90 percent higher in watersheds with high densities of septic systems

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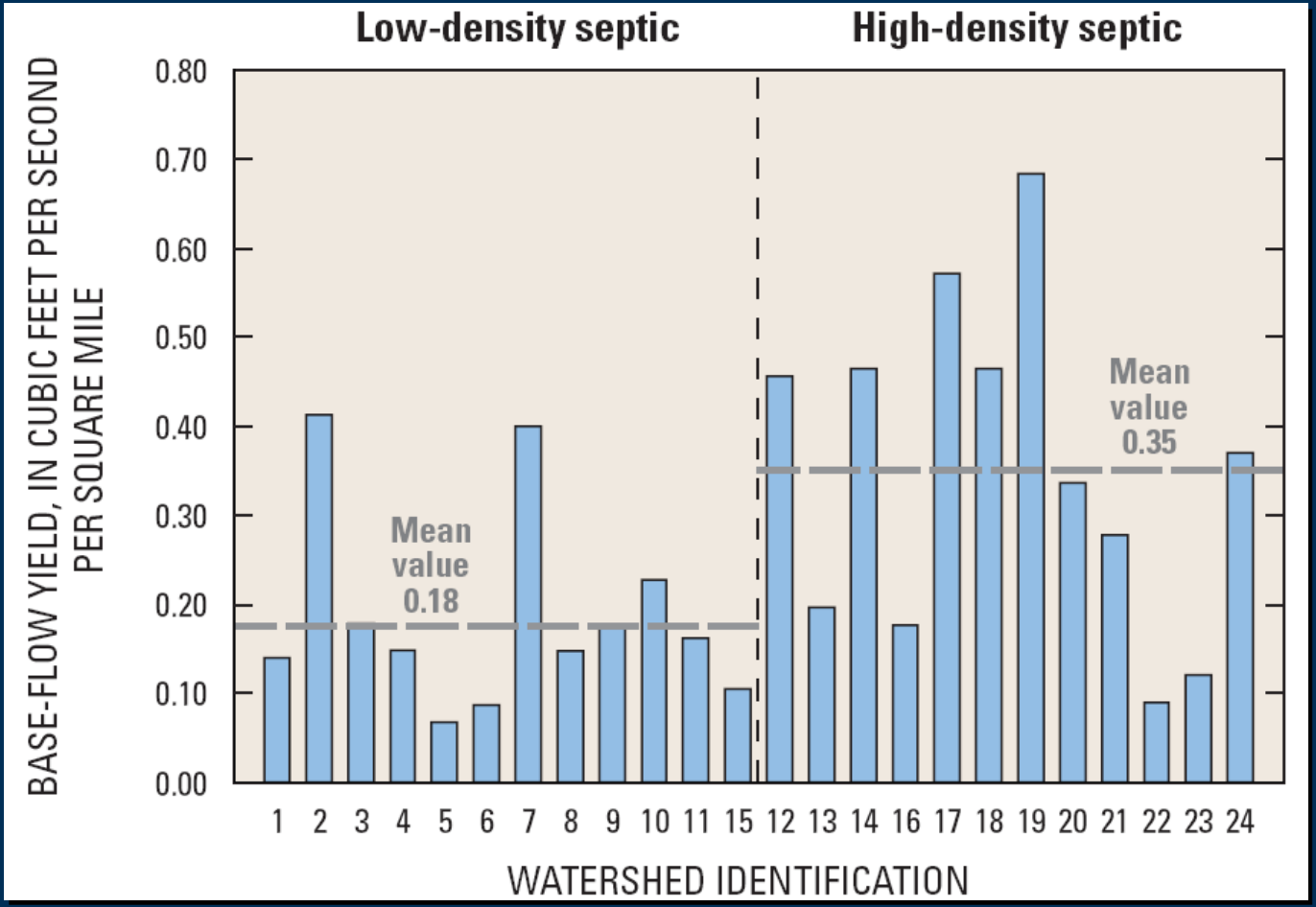
Baseflow Higher in HDS Basins
(Landers and Ankcorn, 2008)



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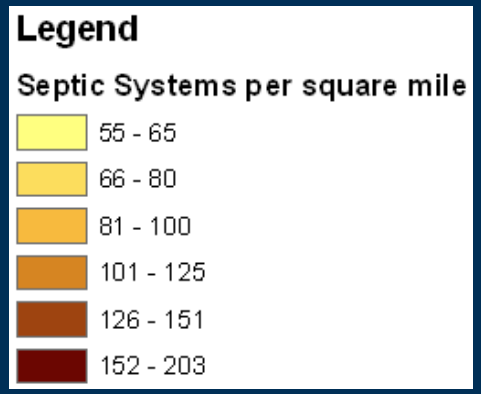
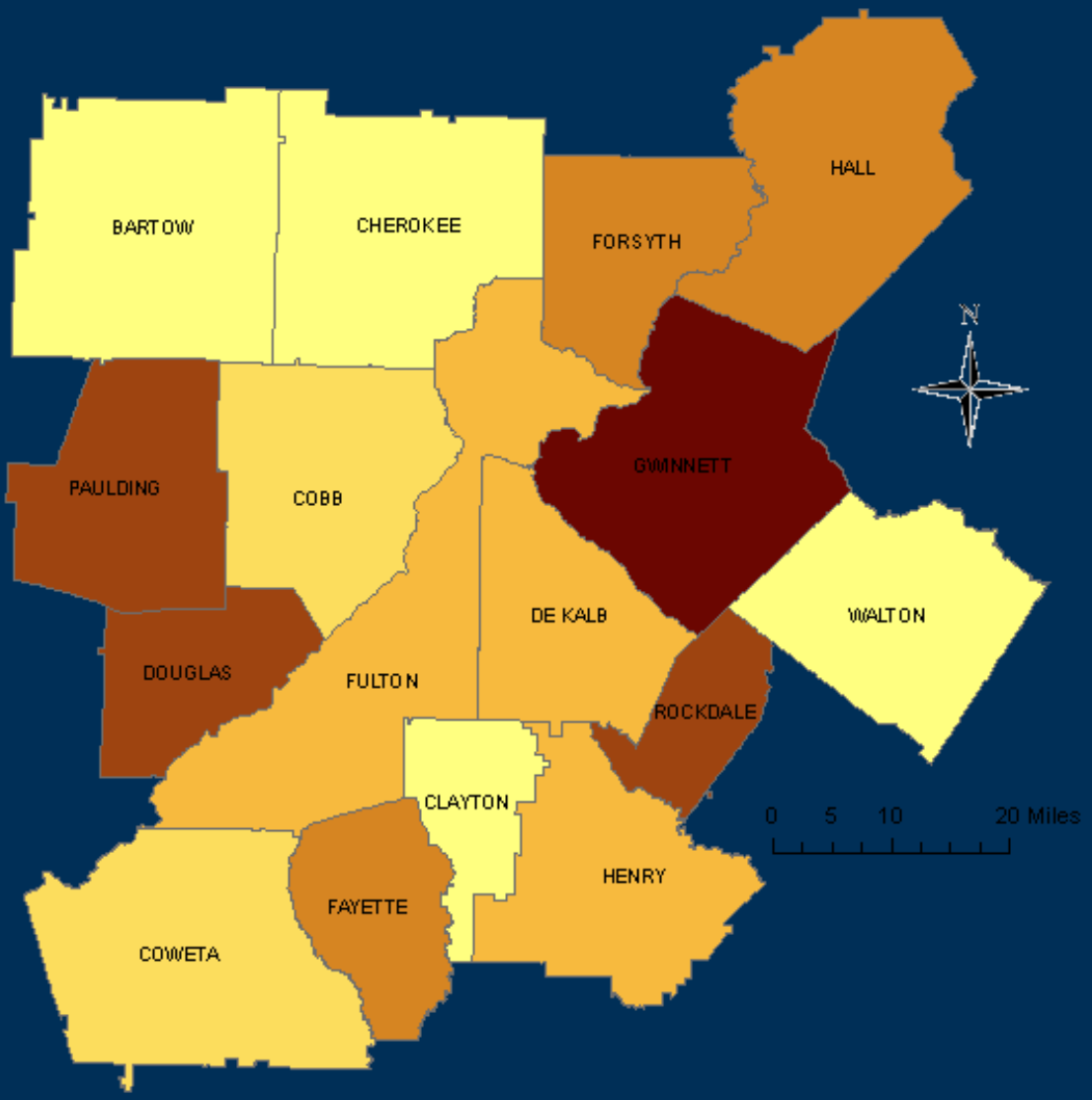
Statistically significant increase (p-value <0.01)

Septic Systems in Metropolitan Atlanta

- An Estimated 526,000 Systems in 16-county area in 2005
- An Estimated 12,000 New Systems per Year
- About 26% of Residences





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Septic System Return Flows—Approach

- Focus on northern part of basin (metro Atlanta)
- Select small watersheds having similar geologic and topographic conditions—divide into equal groups having either a high- or low-density of septic systems.
- Develop GIS database—septic systems, geology, topography, detailed hydrography, impervious area, and water supply and sanitary sewer networks
- Quantify GW contribution to streamflow (baseflow)
  - Synoptic measurements (wet/dry seasons)
  - Instrument selected watersheds with streamgages,
  - Quantify baseflow at gaged sites using hydrograph-separation techniques

USGS

Water Use Projections

- Projections of future water use for the ACF basin will be compiled and compared
- Serve as basis for predictive model simulations

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